Section 3 Sevier River Basin
INTRODUCTION

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Introduction

River basin planning provides a framework for orderly development, conservation and preservation of water and other natural resources.

3.1 BACKGROUND

Water planning has always been a part of Utah's early history and development. State water planning was emphasized by the Legislature in 1963. Current statewide water planning was initiated in 1986 and resulted in the State Water Plan (1990).[19] Since then, six of the eleven basin plans have been prepared.

This section of the Sevier River Basin Plan presents the planning principles and purposes and describes the organization and review process for plan preparation. It also discusses the physiographic and hydrologic aspects and water-related history.

The Sevier River Basin Plan describes the water and related-land resources and the problems at a reconnaissance level. Present and projected water demands are presented along with alternative ways to satisfy the needs and demands of the local people. Pertinent issues are discussed, along with recommendations for resolving them. Studies by the Division of Water Resources and others provided data and information to prepare this plan. See Section B, Bibliography. This plan presents information intended to help the local people make decisions to carry out their selected alternatives.

3.2 PLANNING GUIDELINES

The State Water *Plan* (1990)[19] described the basic premises and laid the foundation for statewide water planning, including preparation of this basin plan. This provides continuity so the purposes and principles of the basin plans will be consistent with the statewide plan and with each other.

State water planning is the responsibility of the Division of Water Resources under the auspices of the Board of Water Resources. This plan was developed according to the following principles.

- All waters are held in trust by the state as public property and their use is subject to rights administered by the State Engineer.
- It is our responsibility to leave good quality water for the generations to follow.
- The interests of Utah's residents should be protected through a balance of economic, social, aesthetic and ecological values.
- Where it is difficult to identify beneficiaries for such uses as recreation and aesthetics, they should be included in program costs.
- Public input is vital to water resources planning.
- All residents are encouraged to exercise water conservation.
- Water rights owners are entitled to transfer their rights under free market conditions.
- Water resources projects should be technically, economically and environmentally sound.
- Local, state and federal planning and management activities should be coordinated.
- Local governments, with state assistance as appropriate, are responsible for protecting against emergency events such as flooding and droughts.
- Designated water uses and quality should be improved or maintained unless there is evidence the loss **is** outweighed by other benefits.
- Educating Utahns about water is essential.

The State Water Plan Coordinating Committee provided expertise, data and review. Other state, federal and local agencies, entities and individuals were involved. After the planning, review and approval process were complete, the final basin plan was distributed to the public for their information and use. It was provided to give guidance for water use, conservation, preservation and development, primarily for local entities but also for state and federal agencies.

All data presented in this report from other sources are given in the units used in the original document. This is particularly true of the water salinity data. To maintain consistency for the reader, all water salinity data are shown in mg/L (milligrams per liter). If the data from referenced reports are given in other units, these values will follow in parentheses. See Section A, Acronyms, Abbreviations and Definitions for a description of the water quality units of measurement.

3.3 BASIN DESCRIPTION

The Sevier River Basin, shown in Figure 3-1, is located in central and south-central Utah. Major topographic features are also shown. Extreme changes in elevation, brilliantly colored rock formations, vegetation and climatic variations make the area a pleasant place to live or visit. Skyline Drive (part of the Great Western Trail) along the divide between the Colorado and San Pitch rivers, provides a scenic vista of unending beauty.

The pink Tertiary cliffs of the Markagunt and Paunsaugunt plateaus are described by Captain C.E. Dutton:[25]

"Even to the mere tourist there are few panoramas so broad and grand; but to the geologist there comes with all the visible grandeur a deep significance. We stand upon the great cliffs of tertiary beds which meanders to the eastward till lost in the distance . . . To the west the Basin Ranges toss up their angry waves in characteristic confusion, sierra behind sierra."

From these colorful borders, one is led down the gentle slopes of the plateaus with their ponds and lakes, through forests of pine and aspen to the river valleys below. Thence, the path leads to the vast delta built by the Sevier River and molded under the influence of ancient Lake Bonneville where it emerges into the Sevier Desert; then into the simmering desert with its barren mountains and vast expanse; here the river dissipates into a dry lake playa, Sevier Lake.

The Sevier River Basin is bounded on the south by the Kanab Creek/Virgin River Basin, on the east by the West Colorado River Basin, on the north by the Utah Lake Basin, on the west by the Great Salt Lake Desert Basin and on the southwest by the Cedar/Beaver Basin.

The "backbone" or Wasatch Line (a high curving belt of mountains and plateaus), a portion of which runs northeasterly from the Markagunt Plateau to Mt. Nebo, roughly divides Utah into the High Plateaus of the Colorado Plateau (highest in North America) on the east, and the Basin and Range Province on the west.

The East Fork of the Sevier River (including Otter Creek) and San Pitch River are the major tributaries of the Sevier River. Chicken Creek and Pigeon Creek feed the Levan-Mills area and Chalk, Meadow and Corn creeks are important streams in Pahvant Valley.

The headwaters of the Sevier River rise in the Markagunt Plateau (Cedar Mountain). The East Fork of the Sevier River originates near Bryce Canyon on the Paunsaugunt Plateau, while the San Pitch River is a product of the Wasatch Plateau.

Asay and Mammoth creeks join together above Hatch to become the Sevier River which flows northward to Piute Reservoir. The East Fork flows northward to Antimony and is joined by Otter Creek where it turns to the west and into Piute Reservoir. From here, the Sevier River flows northward and is joined by the San Pitch River just before emptying into Sevier Bridge Reservoir. At this point, the river makes a broad turn to the west and southwest, flows through the Delta area and terminates in Sevier Lake.

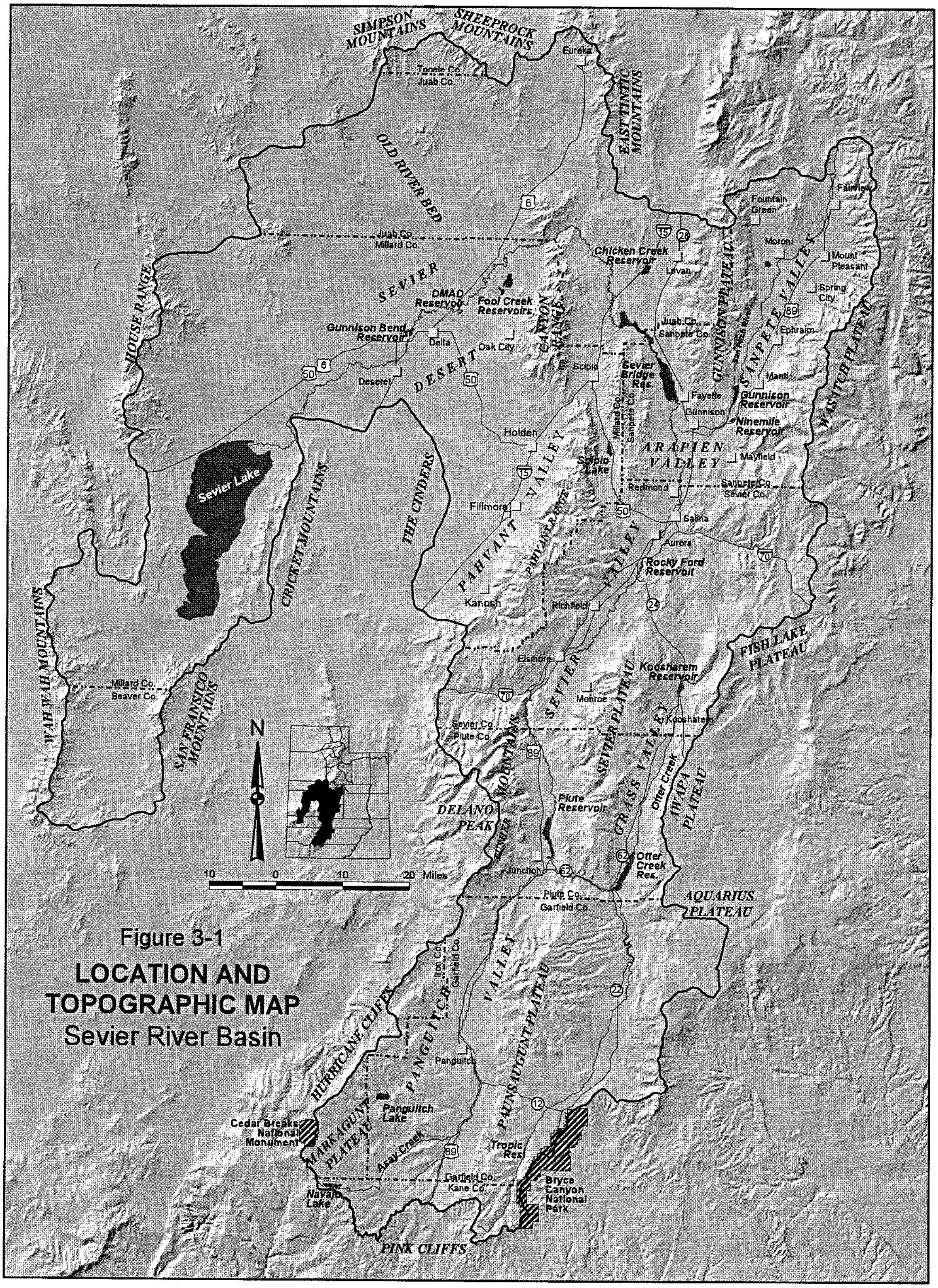


Figure 3-1
LOCATION AND TOPOGRAPHIC MAP
Sevier River Basin

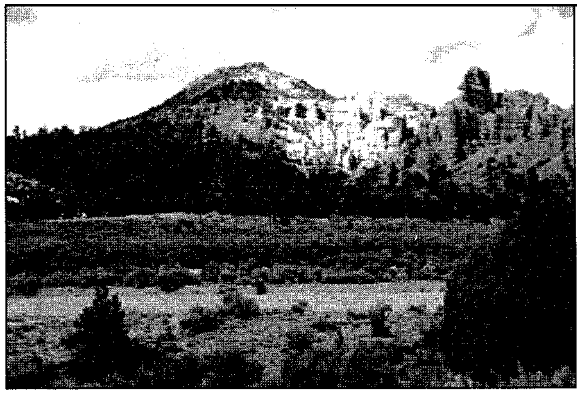
3.3.1 Physiography and Geology [57,63]

The Sevier River Basin contains 6,768,070 acres (10,575 square miles); is about 180 miles from north to south and 125 miles from east to west. It includes parts of Beaver, Garfield, Iron, Juab, Kane, Millard, Piute, Sanpete, Sevier and Tooele counties. It includes the drainage of the Sevier River proper and the Fillmore-Kanosh area, often called Pahvant Valley. These areas, along with the drainage of the Beaver River, make up the Sevier Lake Sub-Region. These are all part of the landlocked Great Basin Region.

Throughout the vast expanse of geologic time, the areas contained within the boundaries of the Sevier River Basin have undergone tremendous change. The basin has been covered seven times by marine seas and once by a great system of freshwater lakes. It has been an enormous and majestic highland as well as a humid, subtropical area dotted with swamps. Once it was a vast desert covered by sand dunes. Evidence for all these changes is recorded in the rock layers exposed within the area. The Sevier River Basin now contains some of the outstanding physiographic and geologic features in Utah. These features include the broad expanse and sheer cliffs of the Markagunt and Paunsaugunt Plateaus, the lofty Tushar Mountains, high mountain valleys, the Wasatch monocline and the Sevier Desert and its serrated mountain ranges.

The Sevier River once terminated in ancient Lake Bonneville near the present town of Axtell, south of Gunnison. All of the Sevier Desert and Pahvant Valley were under water. As Lake Bonneville receded, the Sevier Lake drainage flowed into the Great Salt Lake by way of the "old river bed." This channel, north of Delta, is 45 miles long, from 1,000 to 5,000 feet wide and 100 feet deep near the Simpson Mountains. It is about 4,630 feet in elevation. In more recent times, the Sevier River was joined by the Beaver River southwest of Delta and flowed into Sevier Lake, now usually a dry playa.

Prominent mountain ranges and geologic features separate the Sevier River basin from other drainages. The Sevier River basin is



Sevier fault near Red Canyon

bounded on the south by the Pink Cliffs of the Grand Staircase and on the east by the Aquarius and Awapa plateaus. The Wasatch Plateau and southern Wasatch Mountains are on the east and north. The northern boundary runs along the Tintic and Sheeprock mountains to Topaz Mountain. The House Range defines the western edge from where the boundary crosses to the east around the south side of Sevier Lake, north of Clear Lake and to the transition between the Pahvant Range and the Tushar Mountains. From here, the boundary runs south along the Tushar Mountains to the rim of the Markagunt Plateau which forms the southwest boundary.

The topography is diverse. The irrigated valleys lie between 4,600 and 7,000 feet above sea level. The highest point is Delano Peak in the Tushar Mountains at 12,173 feet. There are 12 other peaks rising more than 11,000 feet above sea level. Over its 250-mile course, the Sevier River falls 2,500 feet from its confluence with Asay Creek south of Hatch to the 4,518-foot elevation of Sevier Lake. The average fall is 10 feet per mile, varying from 3 feet per mile near Delta to 23 feet per mile through Marysvale Canyon.

Within the mixed physiography, each plateau and mountain range has its own character, influencing soils as well as surface and groundwater hydrology. Past erosion and deposition cycles have left piedmont benches and terraces. Erosion has produced the spectacular scenery of Bryce Canyon and Cedar Breaks.

Prior to Lake Bonneville, geologic restrictions across the drainage of the Sevier River and its tributaries at several locations formed the groundwater reservoirs.

Rocks from all eras of geologic time are represented, but most of the area is covered by either Tertiary volcanic or Jurassic, Cretaceous, Tertiary or Quatemary sediments. Quarternary basalts are found on the Markagunt and Paunsaugunt plateaus and in the Sevier Desert (See Figure 3-2).

Two major faults trend northeasterly through the area. The Paunsaugunt fault runs from northern Arizona, past Bryce Canyon and through Grass Valley. The Sevier fault runs from near Pipe Springs in northern Arizona, through the eastern side of Sevier Valley, and into Sanpete Valley to the Cedar Hills. The maximum displacement of these faults, downthrown on the west, is about 2,000 feet. The Elsinore fault on the west side of Sevier Valley, although smaller, is one of the most active faults in Utah. There are major thrust faults in the Pahvant and Gunnison plateaus and in the Canyon Range. The Wasatch monocline, with a maximum displacement of more than 8,500 feet, is the one major fold. See Figure 3-2 and Figure 13- 1.

Minerals include numerous deposits of hydrocarbons, metallic and nonmetallic minerals, and other associated materials. Most of the deposits are noncommercial at present with the exception of the beryllium mining operations northwest of Delta and gypsum processing near Richfield. Mineral fuels (coal) are mined extensively in Salina Canyon, much of the production for shipment to Japan and for use by the coal-fired electrical generating Intermountain Power Project. There have also been minerals extracted from brine at the south end of Sevier Lake where halite and potassium sulfate were produced. Rock salt is mined near Redmond for use by animals. It is also processed for use as table salt.

Early-day mining has periodically influenced the area's economy. By 1917, Tintic Mining District was second only to Bingham with total production valued at $180.4 million. Other districts included Piute County, $3.7 million and West Tintic $139,000. Uranium mining became important near Marysvale during the 1950s and 60s. Eureka, Kimberly and Marysvale have been mining boom towns.

3.3.2 Climate[3,44]

The climate of the Sevier River Basin reflects its location in the transition zone from the Basin and Range Province to the Rocky Mountain-Colorado Plateau Province. The high mountain valleys in the upper drainage areas blend into the semi-arid climate common to the southwest deserts. The northern part of the basin reflects different storm patterns than the southern part.

There are 36 National Weather Service climatological stations located throughout the basin. These have varying lengths of records. Data from 12 of these at selected representative locations based on the period 196 l-90 are listed in Table 3-l. These 12 stations are representative of the valley areas. Winter snowfall is measured at 13 automated SNOTEL data collection sites and 17 manual snow courses by the Natural Resources Conservation Service. The 12 climatological, 10 SNOTEL and seven snow course stations and sites are shown on Figure 3-3.

Mean annual temperatures vary from a high of 50.9" F at Fillmore to a low of 43.6" F at Koosharem. The record high temperature is 110" F at Delta and the record low is - 40" F at Scipio. At some stations, temperatures are around 100" F every summer and fall to below zero in the winter.

Precipitation is influenced by two major storm patterns: one, frontal systems from the Pacific Northwest during winter and spring; the other, late summer and early fall thunderstorms from the south and southwest. These systems are further influenced by the topographic aspects of the area. A study was made in the 1960s by the Natural Resources Conservation Service[63] to determine the effect of storm paths on snow packs.

The average 193 l-60 snow water equivalents were plotted for eight snow courses in the Sevier River Basin north of Gunnison along with 13

SEVIER RIVER BASIN
GENERALIZED GEOLOGIC UNITS

Quaternary

Qa Unconsolidated deposits of alluvium, colluvium, windblown and glacial origin, includes some quatemary basalt flows in the Sevier Desert, and the area between Panguitch and Navajo Lake.

Ql Unconsolidated deposits of lake or playa origin.

Qls Landslides

Tertiary

T Weakly to semi-consolidated sedimentary basin-filling rocks of the Salt Lake, Sevier River, Green River, Flagstaff Limestone, and Claron (Wasatch) Formations. Also, other valley-filling alluvial, lacustrine, and volcanic materials.

Tv Igneous rocks of Tertiary age; includes various intrusions such as the Spry Intrusion, also many extrusive units of the west desert and Marysvale volcanic area such as the Mt. Belknap Volcanics, Mt. Dutton Formation, and Bullion Canyon Volcanics.

Mesozoic

M Consolidated sedimentary rocks; locally includes the North Horn, Price River, Indianola, Morrison, Arapien Shale, Navajo/Nugget, Ankareh and Thaynes Formations in the north. In the south it includes the Kaiparowits, Wahweap, Straight Cliffs, Tropic, Dakota, Carmel, Navajo, and Chinle.

Paleozoic/Precambrian

P Consolidated sedimentary rock locally includes the following formations; Oquirrh Group, Manning Canyon Shale, Great Blue Limestone, Humbug, Deseret Limestone, Gardison Limestone, Fitchville, Pinyon Peak, Victoria, Bluebell Dolomite, Fish Haven Dolomite, Opohonga Limestone, Ajax Dolomite, Maxfield Limestone, Ophir and Tintic Quartzite. Precambrian sedimentary and metamorphic rocks locally include the following formations; Mutual, Inkom, Caddy Canyon Quartzite, Papoose Creek, Blackrock Canyon Limestone, and Pocatello.

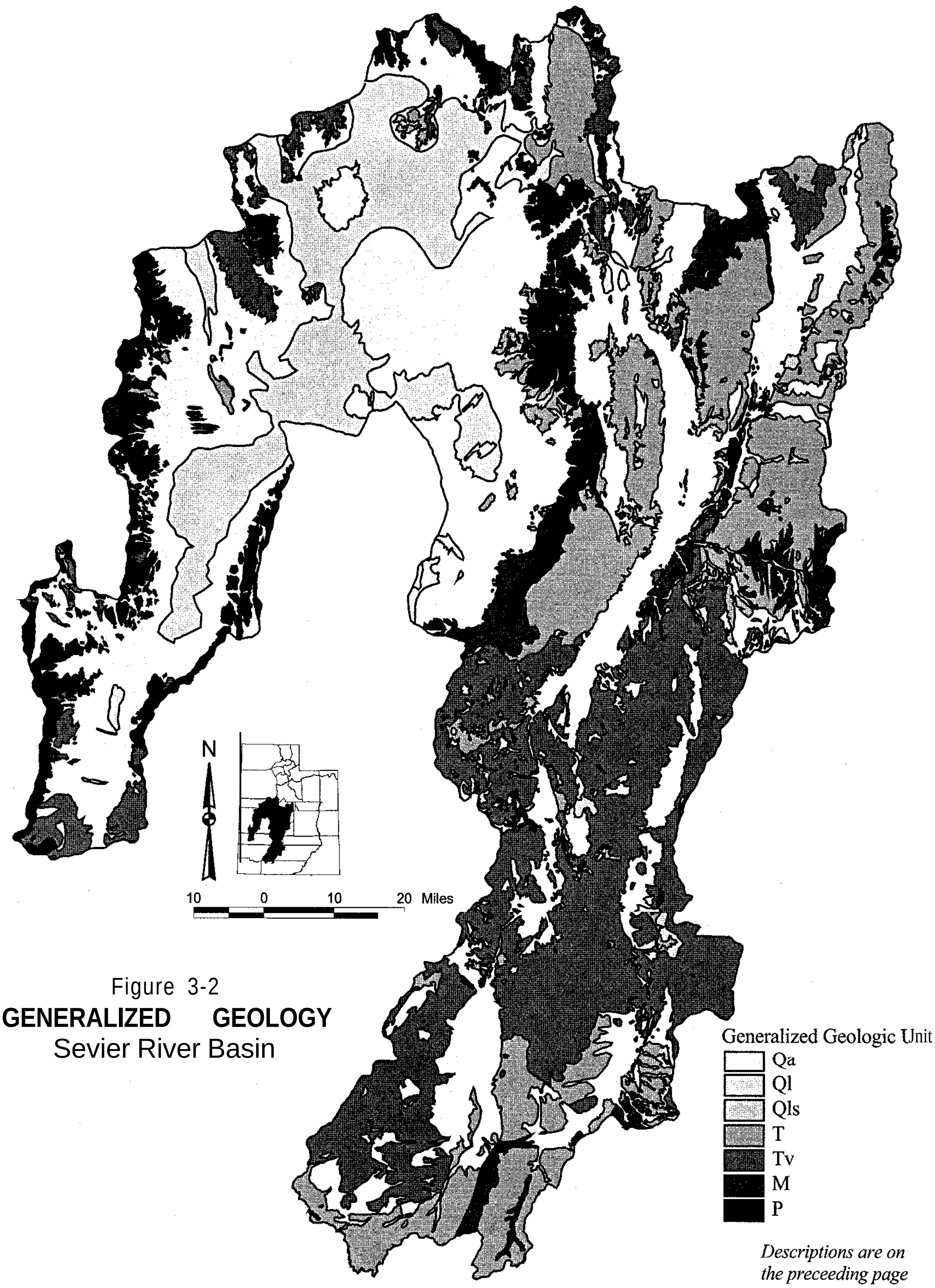


Figure 3-2
GENERALIZED GEOLOGY
Sevier River Basin

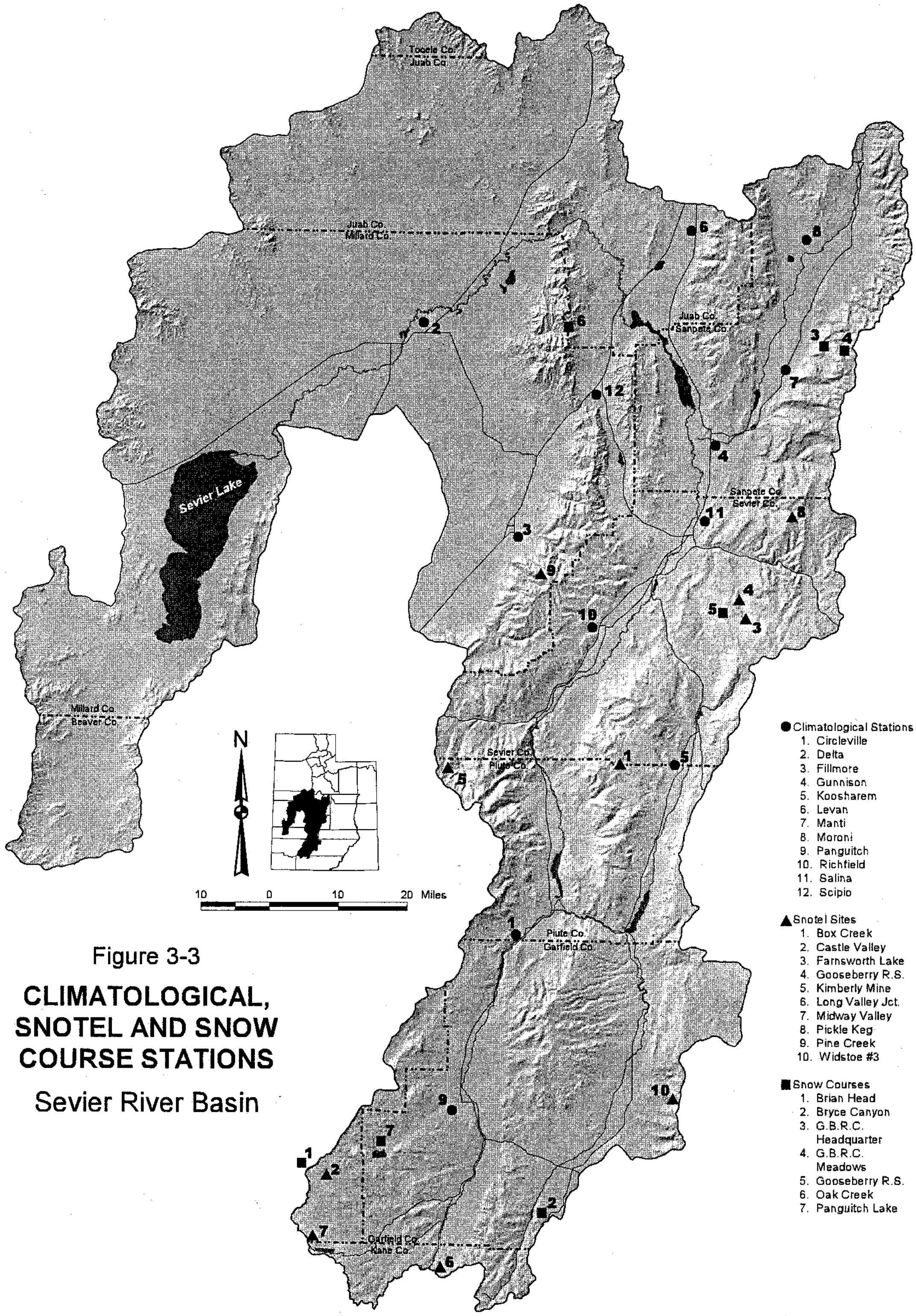


Figure 3-3

CLIMATOLOGICAL, SNOTEL AND SNOW COURSE STATIONS

Sevier River Basin

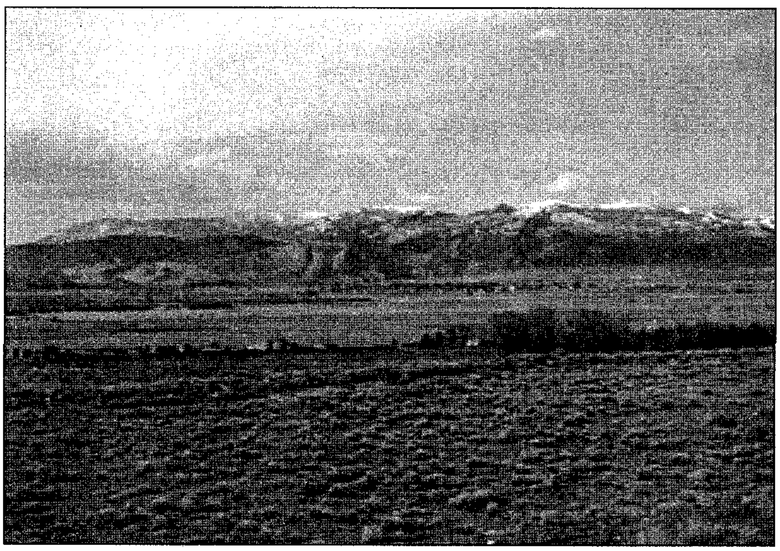
snow courses south of Gunnison. The average snow water equivalents for snow courses north of Gunnison were six inches more than those in the south. This would indicate the effect of the winter storm tracks across Utah. It was also found that wet and dry cycles occurred about every 10-15 years.

Mean annual valley precipitation varies from a high of 16.00 inches at Fillmore, elevation 5,120 feet, to a low of 8.11 inches at Delta, elevation, 4,620 feet, a distance of only 36 miles and 500 feet in elevation. This indicates the influence of topography. Precipitation ranges from more than 35 inches in the highest mountain areas to less than 8 inches in the Sevier Desert. The National Weather Service record measured daily valley rainfall is 2.6 1 inches at Circleville and the record daily valley snowfall is 33.3 inches at Gunnison. Another source states the record 24-hour snowfall was 35.0 inches at Kanosh on February 5, 1953. Figure 3-4 shows the precipitation for the 1961-90 base period. The April 1 readings at the snow courses are used to estimate the stream flows for the coming runoff season. Snow course and snotel data are shown in Table 3-2.

Frost-free days vary from a high of 144 days at Fillmore to 74 days at Panguitch. It is said that freezing temperatures occur every month of the year in Panguitch. The average annual water-surface evaporation is about 40 inches, varying from 43.0 inches at Delta to 35.9 inches at Koosharem. Average wind movement is a low of 40 miles per day in December to a high of 80 miles per day in May in the Sevier River valleys and 100 miles per day in the Fillmore-Delta area. Sunshine varies from a low of about 55 percent of the daylight hours in January to a high of nearly 85 percent in September.

3.3.3 Soils, Vegetation and Land Use

Orville Pratt, Secretary of War, stated in 1848 "The Valley of the Sevier . . . is the finest I have seen since leaving the United States . . . Many thousands acres of the best bottom lands all lie in a body . . . "[78]



Snow capped Tushar Mountains

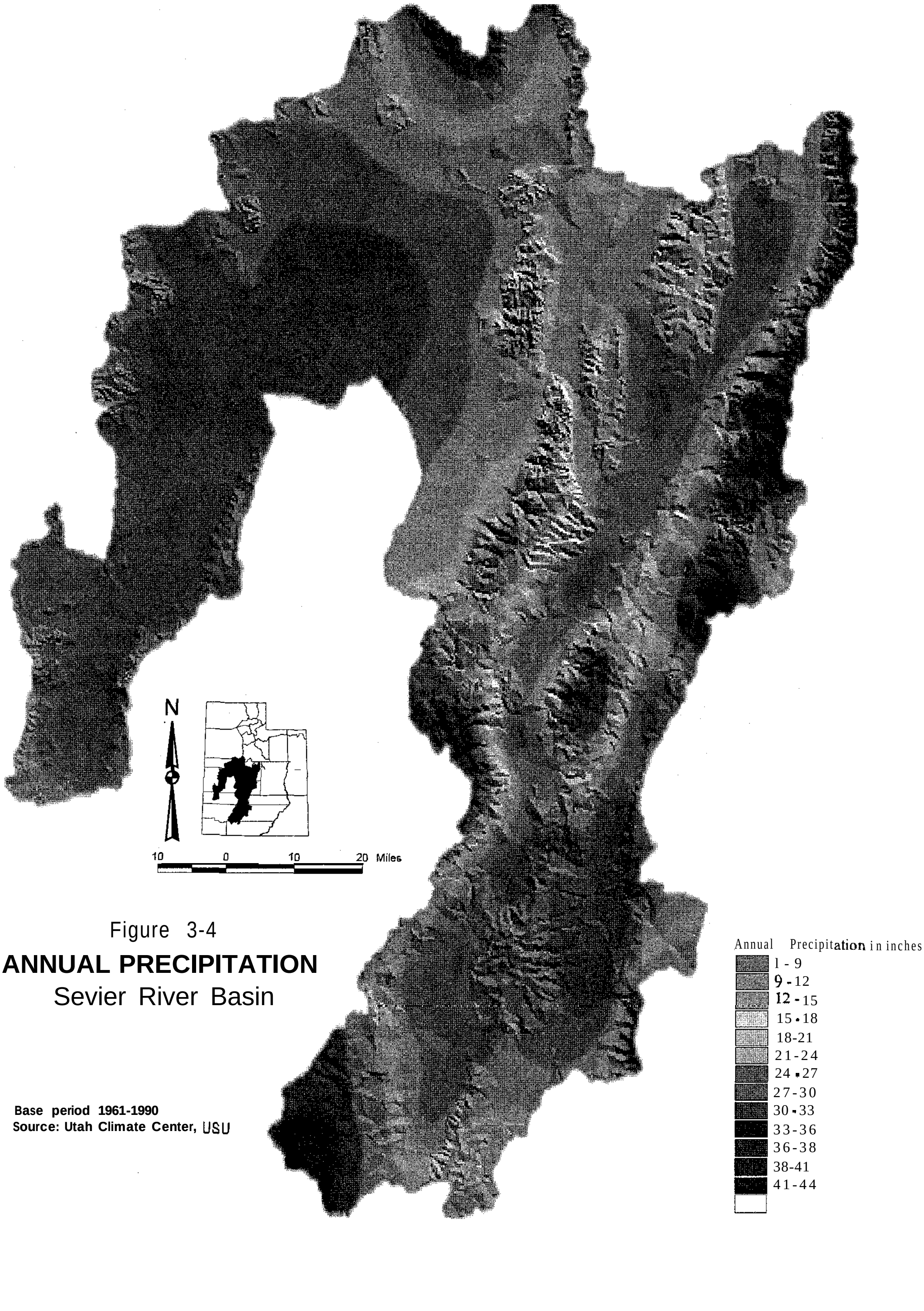


Figure 3-4
ANNUAL PRECIPITATION
Sevier River Basin

Base period 1961-1990
Source: Utah Climate Center, USU

Table 3-1
MEAN TEMPERATURES AND PRECIPITATION
196 l-90 Average

	Station	Temperatures							Frost[a]	Precipitation		
		Jan		July		Mean	Record		Free	Mean	Record Day	
		Max. (°F)	Min. (°F)	Max. (°F)	Min (°F)	Ann. (°F)	Max. (°F)	Min. (°F)	Period (days)	Ann. (in)	Rain (in)	Snow (in)
1	Circleville	41.7	12.5	88.4	52.1	47.3	103	-31	94	8.81	2.61	18.0
2	Delta	36.8	11.2	93.1	57.2	49.6	110	-30	135	8.11	2.59	16.0
3	Fillmore	39.5	16.5	91.6	59.1	50.9	107	-23	144	16.00	2.32	23.0
4	Gunnison	38.4	11.4	91.5	51.4	48.1	104	-28	104	9.18	1.33	33.3
5	Koosharem	38.9	8.4	84.7	46.7	43.6	105	-20	83	9.38	1.46	18.0
6	Levan	37.2	13.4	90.4	56.1	48.9	105	-28	129	15.15	2.00	20.0
7	Manti	36.9	13.9	86.7	54.7	47.6	103	-27	127	13.74	1.67	15.0
8	Moroni	35.6	9.8	89.4	49.3	46.0	102	-27	103	9.87	2.36	14.0
9	Panguitch	40.1	7.8	85.3	46.2	44.3	100	-31	74	10.32	1.87	12.0
10	Richfield	40.6	13.3	89.5	52.4	48.5	104	-33	116	8.57	1.80	16.0
11	Salina	39.9	12.1	92.4	54.1	49.2	105	-32	109	10.13	2.10	14.0
12	Scipio	38.2	9.9	89.7	54.1	47.6	105	-40	102	13.90	2.27	15.0

Note: Numbers in first column indicate station location on Figure 3-3.
Source: Utah Climate, Utah Climate Center, U.S.U.
[a] Frost-free days are between last spring and first fall 32" temperatures.

When Captain C.E. Dutton[25] worked in the area in 1880, he described the broad valley of the Sevier as "treeless and supports but scantily even the desert-loving Artemisia (big sagebrush). It is floored with fine loam, which, under the scorching sun, is like ashes, except where the fields are made to yield their crops of grain by irrigation."

Soils - Soil surveys are made to describe the soil profile and the related vegetation. Land use is generally dictated by the soil types and the vegetation produced. These surveys are published in soil survey reports. The Natural Resource Conservation Service has the responsibility for all soil surveys regardless of land ownership or administration. Under certain conditions, soil surveys are carried out by others such as the Forest Service or Bureau of Land Management.

Soil surveys have been completed or are in progress for most of the private, state and public lands in the basin with the exception of national forest lands. The status of soil surveys is shown on Figure 3-5. Soil surveys conducted at different levels of detail. For all but the most intense surveys, data is collected at three levels: 2nd, 3rd and 4th order mapping described as follows:

> The 2nd order surveys are made for intensive land uses. This type survey is conducted on all cropland areas.
>
> The 3rd order surveys are made for land uses not requiring precise knowledge of small areas or detailed soil information. This type survey is conducted on all

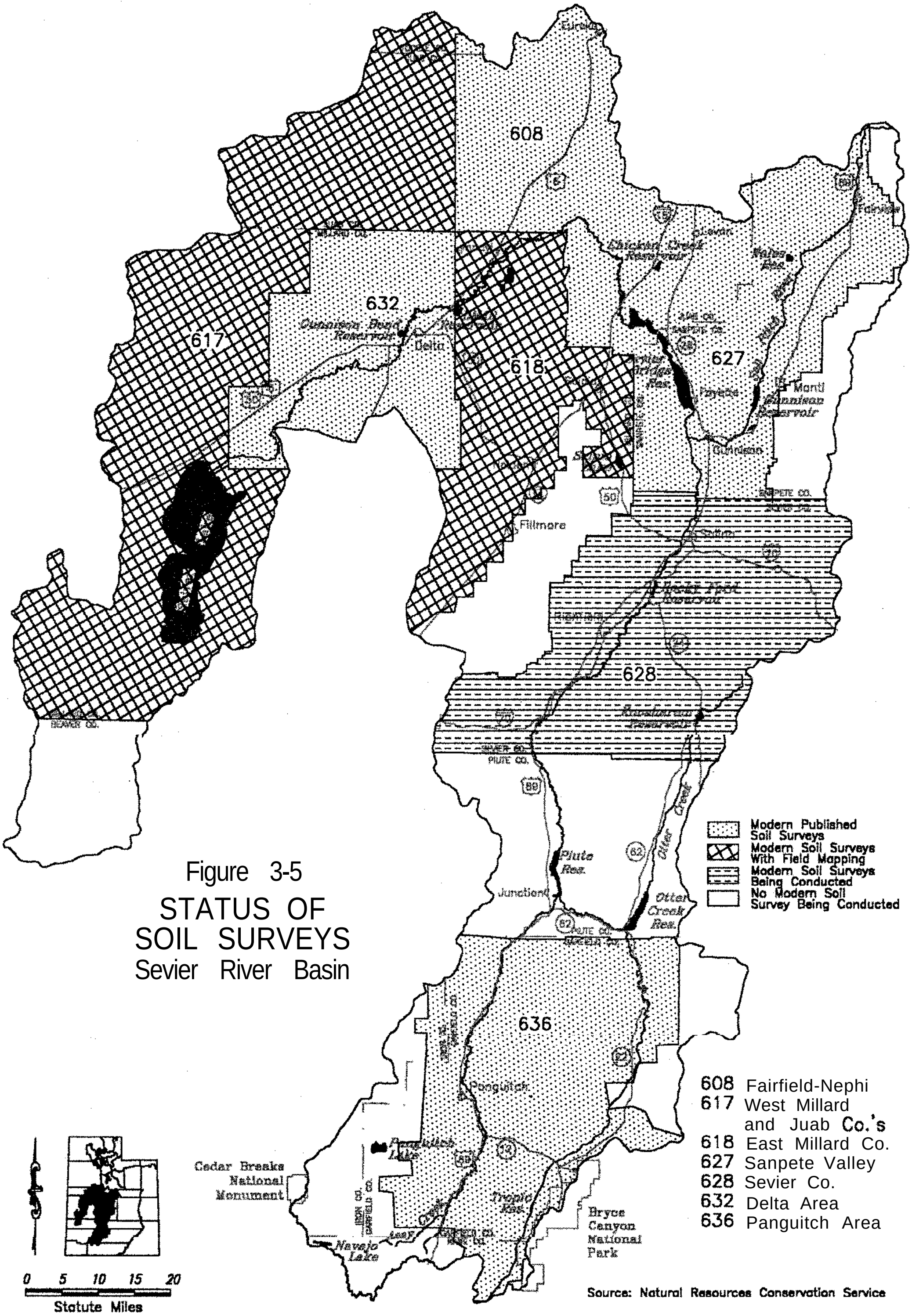


Figure 3-5
STATUS OF
SOIL SURVEYS
Sevier River Basin

national forest lands and the majority of private and public rangelands.

The 4th order surveys are used to provide data for broad land use potential planning and general land management.

Five climatic zones are summarized in Table 3-3. The generalized soil descriptions for these zones are described below.

High. Mountain soils have high development and are usually found on mountain slopes and in mountain valleys. The mollic horizons are organically enriched surface layers. The next or argillic horizon is a textural clay. The pH is about 6.0 to 7.5 due to leaching by the higher precipitation. Most of this zone is used for rangeland and timber production.

Mountain soils are highly developed and are found on mountain slopes. The mollic horizons are organically enriched surface layers. The argillic horizon is a textural clay. The pH is about 7.0 to 8.0 due to leaching by the higher precipitation. Most of this zone is rangeland with some timber production.

Upland soils have moderate development and are found on alluvial fans and hills. The mollic horizons, usually minimally expressed, are organically enriched surface layers. The argillic horizon is a textural clay. The pH is about 7.5 to 8.0 due to the higher precipitation which leaches the calcium carbonate. The majority of this zone is used for rangeland with only a small amount of cropland.

Semidesert soils are deep, generally have very little development and are usually found in alluvial deposits and lake sediments. The surface ochric horizons are light in color. The subsurface calcic horizons show accumulations of calcium carbonates. The pH is more than 8.0. This zone contains most of the cropland.

Desert soils are located in the lowest elevation and precipitation areas. Soils primarily occur on lake bottoms, lake terraces, alluvial fans and flood plains. Soils are generally saline with a pH of over 8.0. The soils are similar to those in the semi-desert zone although there are areas of sand dunes.

Vegetation - There are five vegetative types which occur from the higher elevations with precipitation over 35 inches to the valley floors where precipitation is less than 8 inches. In addition, barren areas include desert playas, recent extrusions of volcanic basalt, and areas covered predominantly with annual weeds such as pickleweed or gray Molly. There is also a barren rock area on the higher flanks of the Tushar Mountains.

Conifer-Aspen Forest is found on mountain slopes and contains mostly white fir, Douglas fir, Ponderosa pine, spruce and quaking aspen. This area produces most of the stream flow, all of the commercial timber and a wide variety of wildlife. Precipitation ranges from 20 to 35 inches and elevations are usually over 8,000 feet.

Mountain Brush occurs on steep slopes with gambel oak, serviceberry and curlleaf mountain mahogany as the predominant vegetation. This area is used for grazing, wildlife habitat and recreation. Precipitation is 18 to 25 inches and elevations are usually between 7,500 feet and 8,500 feet.

Pinyon-Juniper trees lend a pigmy forest aspect to the foothills. Predominant vegetation is pinyon pine and Utah juniper with scattered areas of brush, grasses and forbes. This area provides grazing, wildlife habitat, materials for fence posts and firewood. It is also a source of pinyon pine nuts and a place of recreation. Precipitation is from 10 to 20 inches and elevations range from 5,500 feet to 7,500 feet.

Table 3-2
SNOTEL AND SNOW COURSE DATA
196 l-90 Average

	Station	Elevation	April 1 Snowtel SWE[a] Average
1	Box Creek	9,800	13.8
2	Castle Valley	9,580	14.4
3	Farnsworth Lake	9,600	20.5
4	Gooseberry R.S	8,000	11.7
5	Kimberly Mine	9,300	16.2
6	Long Valley Jct.	7,500	0.1
7	Midway Valley	9,800	24.6
8	Pickle Keg	9,600	18.8
9	Pine Creek	8,800	21.4
0	Widstoe #3	9,500	12.1
			Snow Courses SWE[a] Average
1	Brian Head	10,000	21.2
2	Bryce Canyon	8,000	3.6
3	G.B.R.C. Headquarter	8,700	17.2
4	G.B.R.C. Meadows	10,000	24.2
5	Gooseberry R.S.	8,400	12.5
6	Oak Creek	7,760	12.9
7	Panguitch Lake	8,200	4.0

Snow water equivalents in inches.
Jote: Numbers refer to station location in Figure 3-3.
ìource: Utah Cooperative Snow Survey Data, NRCS.

Table 3-3
CLIMATIC ZONES

Climatic Zone	Precipitation (inches)	Temperature (°F)	Frost Free Period (days)	**Elevation** (feet)
High Mountain	22-40	34-45	40-90	8,000-10,000
Mountain	16-22	42-50	70-170	6,000-8,200
Upland	12-16	45-59	120-170	4,500-6,900
Semidesert	8-12	52-59	120-190	4,500-6-300
Desert	6-8	50-59	120-200	4,500-5,800

Source: Natural Resources Conservation Service

Sagebrush is found at nearly every elevation and range of precipitation on deep, well-drained soils. These areas furnish spring-fall range at lower elevations and summer range for sheep and cattle as well as wildlife habitat at higher elevations. A wide variety of grasses, browse and forbes is found, with big sagebrush the predominant species.

Grass and the Northern Desert Shrub are found at elevations from 4,500 feet to about 5,000 feet where precipitation is from 8 to 10 inches. Important vegetation includes Indian ricegrass, needle and thread grass, winterfat, black greasewood and shadscale. Most of these are found in the bottom lands where soils are affected by salts. These areas provide winter range for livestock.

Land Use - Soils are generally used to provide the highest production or best use according to its capability. The Natural Resources Conservation Service capability groupings show the soil suitability, limitations and expected response to treatment.

Capability classes, the broadest group, are classified on a numerical scale from one to eight indicating progressively greater limitations and narrower choices for agricultural cultivation. Other uses, such as for grazing or, wildlife, may not be as restrictive. The lower class numbers are choice lands suitable for growing irrigated crops. The higher class numbers are more suitable for permanent pasture and progressively to grasslands, forested areas and rocklands.

Lands used for farming can also be defined according to their agricultural production ability and potential. There are two categories describing the better croplands: prime farmlands and farmland of statewide importance. About 144,600 acres of prime farmlands are used for irrigated agriculture.

Less intensively developed areas surround the farmlands. About 92 percent or about 6.2 million acres are used for grazing, wildlife, timber production, mining and other purposes. There are about 500,000 acres of commercial timber. These less intensive developed areas are also used for recreation in a wide variety of pursuits from rock hounding and sightseeing to hunting, snowmobiling and ATV activities.

3.3.4 Land Status

The total area of the Sevier River Basin is 6,768,070 acres. The areas by subbasin are shown in Table 3-4. See Figure 5-l for watershed and subbasin delineations. Private lands cover only about 23 percent of the area. Federally administered lands cover about 69 percent and state lands account for 8 percent. There are about 1,235 acres of Indian Trust Lands located in Sevier County and 500 acres in Millard County. The breakdown of land ownership and administration is shown in Tables 3-5 and 3-6. The federally administered lands are under the jurisdiction of the Bureau of Land Management, Forest Service and National Park Service.

The Manti-La Sal National Forest was established in the Manti area in 1903. The Fish Lake National Forest was first established in 1899 and final boundaries were established in 1911. The Dixie National Forest, originally the Aquarius, was designated in 1903. The original Uintah National Forest was established in 1897. The name was changed to Uinta in 1906.

Originally called the Temple of the Gods National Monument (1919), Bryce Canyon National Park was established in 1928. Its total area is now 37,277 acres. Cedar Breaks National Monument, originally part of Powell National Forest, came into being in 1933. Its total area is now 6,154 acres.

3.4 WATER-RELATED HISTORY

Between 1000 A.D. and 1500 A.D., 8,000 years after Lake Bonneville had receded from the Sevier River Basin for the last time, volcanos erupted and deposited black lava flows in the Navajo Lake area of the Markagunt Plateau. They also deposited lava in areas of the Paunsaugunt Plateau and on the western side of Pahvant Valley. These lava flows allow the precipitation to penetrate easily, reduce erosion and influence groundwater movement. There is evidence of a large Fremont habitation site, Nawthis Village, along Gooseberry Creek in the Salina Creek drainage that was occupied from about A.D. 800 to 1150.

East of this village site, a buried channel in the alluvial flood plain has been exposed by a recent mudslide. It appears to be the remains of an artificial channel, constructed and maintained by the inhabitants to irrigate their crops. This is evidenced

Table 3-4
BASIN AND SUB-BASIN AREAS

Name	Area (acres)	Area (sq miles)
Panguitch Valley	623,530	974
East Fork Sevier	801,680	1,253
Junction-Marysvale	418,150	653
Sevier Valley	909,930	1,422
Sanpete Valley	555,170	867
Scipio-Levan	696,940	1,089
Delta	2,266,300	3,541
Pahvant Valley	496,370	776
Total	6,768,070	10,575

Source: Hydrologic Inventory of the Sevier River Basin, Division of Water Resources

Table 3-5
LAND OWNERSHIP AND ADMINISTRATION

County	Private	State (acres)	Federal	Total
Beaver	13,540	18,990	165,760	198,29(
Garfield	112,440	63,470	784,520	960,43(
Iron	9,880	1,520	115,980	127,38(
Juab	239,420	78,460	731,150	1,049,03(
Kane	21,160	120	76,070	97,35(
Millard	475,350	213,820	1,508,100	2,197,27(
Piute	64,910	5 1,440	352,150	468,50(
Sanpete	396,330	62,500	293,990	752,82(
Sevier	236,080	48,800	590,810	875,69(
Tooele	3,860	3,110	34,340	41,31(
Total	1572.970	542.230	4.652.870	6.768.07(

Table 3-6 FEDERAL LAND ADMINISTRATION						
County	Forest Service	Bureau of Land Mg't	Native American (acres)	Dept of Defense	Park Service	Total
Beaver	420	165,340	0	0	0	165,760
Garfield	590,310	187,920	0	0	6,290	784,520
Iron	103,800	11,700	0	0	480	115,980
Juab	76,480	654,560	0	110	0	731,150
Kane	73,340	250	0	0	2,480	76,070
Millard	271,400	1,236,200	500	0	0	1,508,100
Piute	188,590	163,560	0	0	0	352,150
Sanpete	179,950	113,270	0	770	0	293,990
Sevier	476,680	112,895	1,235	0	0	590,810
Tooele	14,620	19,720	0	0	0	34,340
Total	1,975,590	2,665,415	1,735	880	9,250	4,652,870

by abundant corn remains and less common remains of beans and squash. When the first white men entered south-central Utah, they found the Western Utes living as roving bands; the Pahvants around Fillmore and Sevier Lake, and the San Pitch around Sanpete Valley. By 1847, there were less than 20,000 Native Americans in all of Utah.

Discovered by various explorers at different locations and times, the Sevier River was called by various names. The Dominguez-Escalante Expedition camped in Mills Valley near the Sevier River (west of Levan) on September 29, 1776. Their last camp in the Sevier River Basin was near Sugarloaf (Pahvant Butte). The explorers' cartographer, Don Bernardo de Miera, named what is now Sevier Lake after himself and called the river Rio Buenaventura, the "river of the good journey." In 1813, the traders Moricio Arce and Lagos Garcia called it the Rio Sebero (also reported as Severo or Seviro -- Spanish for severe or violent). This is the most likely source of the name "Sevier River."

Jedediah Smith opened up the beginnings of the Spanish Trail in 1826 when he traveled down Salina Canyon, up the Sevier River (Smith called it Ashley's River) to Clear Creek where he crossed over to Cove Fort. The most used portion of the Spanish Trail went down Salina Canyon, along the Sevier River to near Joseph and over the low hills to Marysvale and on up to Orton, up Bear Valley and over to Red Creek and Paragonah. A trapper, Daniel T. Potts, traveling the lower Sevier River, called it Rabbit River because of the great number of jack rabbits. William Wolfskill and George C. Yount, while traveling the Old Spanish Trail, spoke of the river the Indians called the Pooence.

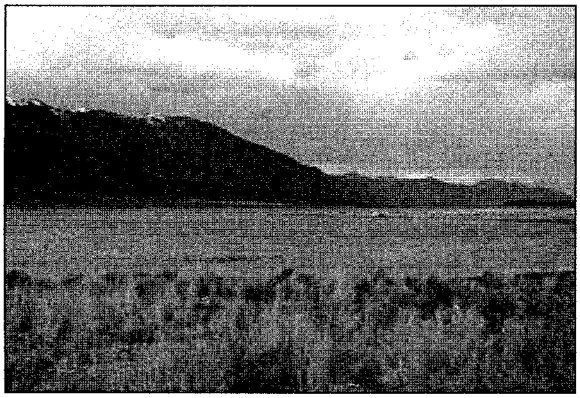
The first Anglo settlers arrived in Sanpete County in 1849. They probably diverted water to irrigate their crops in the spring of 1850. This was the first diversion for irrigation in modem times. Soon there were settlements in Pahvant Valley (1851), Mt. Pleasant and Ephraim (1852), Deseret (1857), Gunnison (1859), Monroe and Salina (1863), Richfield and Panguitch (1864) and Grass Valley (1867).

The territorial legislature passed a joint resolution on October 4, 1851 creating Millard County from the portion of Iron County known as Pahvant Valley and made Fillmore the county seat. This resolution also relocated the territorial capital to Fillmore. Two companies left Salt Lake City for

Pahvant Valley. One was headed by Brigham Young to select the site of the territorial capital; the other, headed by Anson Call, was to establish the settlement.

3.4.1 Early Water Development

As soon as settlers were established, they started developing local water resources for domestic use and irrigation. Water was first diverted from the Sevier River mainstem near Deseret in 1860. This dam was abandoned in 1889. Water to serve the Deseret, Hinckley and Oasis area has been diverted at Gunnison Bend from 1889 until the present, first from a diversion structure and later from the reservoir.



Scipio Reservoir-Constructed in 1860

One of the more detailed descriptions given was of the construction of the Richfield Irrigation Canal in 1865. This 1 l-mile long canal was dug with pick and shovel and completed in the amazing short time of five weeks.[78]

Increasing numbers of settlers put more and more land under irrigation until the resources of the Sevier River were completely utilized. Those higher up on the river were inclined to take the water as long as it was available, whether it was theirs by priority or use, or belonged to others lower downstream. When the demand for water was the greatest, the stream flow was the least. It soon became apparent dams were needed to store water for use later in the season. The first was Scipio Reservoir, constructed in 1860, to store irrigation water from Ivie Creek. Panguitch Lake was next when the dam was completed in 1872.

The years from 1890 until about 1915 were the dam-building years when most of the reservoirs were constructed. Refer to Table 6-1 for more data on reservoirs. During this same time, two of the longest canals in the state were completed; the 65-mile Sevier Valley-Piute Canal and the 52-mile Central Utah Canal. The Central Utah Canal now terminates at the Fool Creek Reservoirs.

The Delta-Melville diversion dam north of Delta was built in 1907. It washed out in 1909 and was rebuilt. It washed out again in 1910 and was eventually rebuilt 4-1/2 miles upstream at the present location of DMAD Reservoir.

Gunnison Reservoir is located about one-half mile above the mouth of Six Mile Creek on the San Pitch River. The original earth fill dam, 23 feet high, was built about 1890. The middle section washed out before July 1891. In 1900, the dam was raised to 40 feet with an outlet tunneled through solid rock. The dam is owned by the Gunnison Irrigation Company with a storage right for 20,264 acre-feet and a priority date of 1860. The spillway was rebuilt after the heavy flooding of 1983.

Gunnison Bend Reservoir, owned by Deseret Irrigation Company and Abraham Irrigation Company, was surveyed in 1885 and first stored water in 1891. It was enlarged to its present capacity in 1898.

A severe drought beginning in 1895 prompted plans by Sevier Valley farmers to build reservoir storage to regulate the seasonal flow of the river. The first work was done in April 1897 to legally claim title to the site of Otter Creek Reservoir near Antimony. Construction was started in October 1897 under the direction of Robert D. Young after an on-site inspection by the State Engineer. The dam was completed in 1901. Many of the work crew were boys, as the fathers had to stay home to take care of the farms. Otter Creek Reservoir is now cooperatively owned by a consortium of ten irrigation companies.

After a series of extremely dry years and many meetings, the Deseret Irrigation Company decided to construct a dam at the Sevier River Bridge near Juab to store water for irrigation.' On August 26, 1902, Jacob C. Hawley posted a notice for appropriation of water and selection of the site near the Sevier River Bridge. Construction started during October 1902. During the period 1903-07,

nearly every available man and.boy in Deseret, Oasis and Hinckley worked at the dam. Sevier Bridge (Yuba) dam was completed to 40 feet in the spring of 1906 and raised to 66 feet with the spillway at 60 feet in 1907. In 1908, Deseret Irrigation Company sold one-half interest of the Hawley filing to Melville Irrigation Company and two-sixths interest to Oasis Land and Water Company. Melville Irrigation Company then
sold one-sixth interest to Oasis Land and Water Company.

An additional agreement known as the Four-Party Contract was negotiated in 1913 to raise the dam 30 feet to store an estimated 250,000 acre-feet. The dam enlargement was completed in 1916. The present capacity is 236,145 acre-feet. Parties to the contract were Sevier River Land and Water Company, Deseret Irrigation Company, Delta Land and Water Company, and Melville Irrigation Company.

The Piute Project has a history of its own. Although it was started by the local people, the project was completed by the State Board of Land Commissioners. The Piute Reservoir dam was surveyed in 1907 and the site was filed for on August 21, 1908. The dam was originally completed in 1914. Considerable work was done later but was designated as rebuilding. The Piute Reservoir, with a present capacity of 7 1,826 acre-feet, was to furnish irrigation water for about 20,000 acres in Sevier and Sanpete counties from a point two miles north of Richfield to an area west of Fayette. The state owned about 11,000 acres of this land and a Jewish colony at Clarion bought 5,000 acres.

The depression and drought of the 1930s reduced the farmers' ability to repay loans to the State Land Board for projects the Central Utah Water Company and the Piute Reservoir and Irrigation Company had built. The Central Utah Water Company had borrowed money from the State Land Board to build a canal system and pay reservoir costs. They still owed $452,500. The Piute Reservoir and Irrigation Company was in similar straits, owing money for a reservoir and canal. Their remaining obligation was $545,577.'

It appeared the State Land Board did not have much hope of collecting any of the monies due. After much study, it was decided the State Land Board was to foreclose on the mortgages and claim title to the projects for the state. When the Legislature convened in 1937, it decided to sell the Central Utah Water System and the Piute Reservoir and Irrigation Company System to these companies for the consideration of one dollar each. This was passed March 11 and approved March 22, 1937. The acceptance of $1 .OO each for complete payment gave the companies back to the original owners and relieved the State Land Board of a difficult problem.

The Hatch Town Dam was located just over a mile south of the town of Hatch. The first dam built at this site was constructed in 1900 by a private irrigation company. It was a small, earth-fill dam with a lime-mortar culvert. The dam soon started to leak and subsequently washed out. A second dam was built by May 1901. It was 40 feet high with a timber spillway four feet deep and 20 feet wide located near the middle of the structure. Spring flooding and an inadequate spillway caused overtopping of the dam. The entire structure was carried away except for part of the culvert.[56]

From 1906-08, the State Land Board reconstructed the Hatch Town Dam to impound water for irrigation of about 5,700 acres on the Panguitch Bench. The land was sold to colonizers, mostly from Missouri. The total cost of the dam and canal was $329,185 and was paid from the Reservoir Land Grant Funds. When the reservoir filled in early 1910, the gates (since called the Jenson Lock Gates after the construction engineer) were ordered opened but they wouldn't budge. This was reported to the State Engineer who sent the construction engineer down to "show the country guys how to do it." They still wouldn't open so it was decided to give them a jar with a stick of dynamite. The blast jarred the gates open but also created a leak in the culvert wall.

This trouble persisted until on May 25, 1914 at about 8:00 p.m., the dam failed, releasing a wall of water 30 feet high. Flooding reached the flour mill at Panguitch in about two hours. By the next day, Circleville was deserted and a newspaper account stated "Main Street is now a raging river." There was considerable damage along the river valley. Noting urgent appeals for investigation of problems with the dam, the local paper editorialized, "There seems to be no trouble in having State Officers and competent engineers look at the dam or remains of it now." Governor Spry made sure all damages were repaid. The State Land Board considered rebuilding the dam and local initial reaction favored this. Still, the dam was never replaced.

Through all of these active water development years, four important documents were produced. The Higgins Decree, Morse Decree, "Bacon's Bible," and the Cox Decree. See Section 6 for information on these works.

Farming continued to expand as more people moved into the basin. Irrigation companies were formed so the water could be better managed. With the increase in irrigation, alkali began to accumulate in some soils, creating a problem. If the salts were not leached down through the root zone, crop production was reduced. As a result, additional water was applied to control the problem. This in turn raised the water table.

As a result, four drainage districts were organized in the Delta area between 1914-18. These four drainage districts issued bonds for $3 million to install drains under about 80,000 acres. Between 1916-20, seven drainage districts were organized in Sevier County covering 15,000 acres. Total cost of these projects was about $413,000. A small drainage district was organized in Sanpete County covering 3,600 acres. The drainage was installed in 1919-21 at a cost of $95,000.

3.4.2 Recent Water Planning and Development

The only storage reservoirs constructed since the 1936 Cox Decree are Three Creeks Reservoir enlargement (1949, originally built about 1895) in the Clear Creek drainage, DMAD Reservoir (1960) on the Sevier River, Manning Meadow Reservoir (1967) on Manning Creek and reconstruction and enlargement of Nine Mile Reservoir to restore its original capacity (1982) on the San Pitch River. Three Creeks Reservoir was constructed with private funding while the other three reservoirs received financial help from the Board of Water Resources.

In 1956, the Sevier River Water Users requested a review of the water and related land resources problems. After many meetings and several somewhat unrelated but important work programs had been started, the Sevier River Study Group requested a "framework plan" be formulated for the coordinated development of water and related land resources. The principal features of the study included the following items: 1) Salvage of water from phreatophytes, controlling groundwater tables and improving irrigation and drainage systems; 2) management of stream flows and more efficient transportation of water supplies through the main river channel; 3) review of groundwater conditions as they relate to return flow, drainage, phreatophyte control and the location, extent, and availability for use of groundwater supplies; 4) relationship of public and private lands and the use of water on these lands as they affect other water related activities; and 5) opportunities for adjustments in use and management of land, water and other resources and possible economic development.

Governor George D. Clyde, in response, made a formal request for assistance from the U.S. Department of Agriculture. As a result, a field party was established in 1960 under provisions of Section 6 of the Watershed Protection and Flood Prevention Act. The State Engineer was assigned to carry out the state of Utah's responsibilities.

This reconnaissance study resulted in the publication of a summary report, twelve numbered appendices and two unnumbered reports. The final document was an Early Action Program (1970) for accelerated development of the water and related-land resources as requested in the objectives and principal features of the plan of work.[63] This coordinated total resources development program would entail a total cost of $56.1 million of which $39.0 million would be federal funds and $17.1 would be non-federal. About 97,000 acre-feet of water would be developed and 632,000 acre-feet of groundwater would be available for dry-wet year management. After a series of public meetings, the program was rejected by the lower basin water users because of the impact on water rights.

In 1968, Governor Calvin L. Rampton requested the U.S. Department of Agriculture to expand the Sevier River Basin Water and Related-Land study to include all of the Sevier Lake Drainage. Part of the area added included Pahvant Valley, Tintic Watershed and Sevier Lake which, along with the original Sevier River Basin Study, now makes up the area covered by this Sevier River Basin Plan.

In 1967, counties in the Sevier River Basin petitioned to join the Central Utah Water Conservancy District. They hoped to obtain water through the Central Utah Project to supplement the existing irrigation water supplies. Their petition was enjoined and they were to receive a gross diversion of 36,000 acre-feet. After a number of years, it appeared the federal requirements for the use of project water were becoming too stringent. It was felt the federal claim to all the return flow and waste water resulting from the project would jeopardize the rights of users who could not participate in an exchange with Sevier Bridge Reservoir. There were increasing environmental concerns along with some other unresolved problems. As a result, in June 1994, Millard County petitioned and was released from the district. Sevier County followed suit in September 1994.

Garfield, Juab, Piute and Sanpete counties are still members of the Central Utah Water Conservancy District and pay taxes for its operation. Membership and future participation will have to be resolved. Some funding has been obtained under the Mitigation and Conservation Plan for water conservation and development.

The Soil Conservation Service(SCS) implemented four flood prevention and irrigation water projects in the basin. In addition, three other projects were carried to various stages of completion. These are described below.

Under a pilot program, Utah was awarded two of 11 national flood prevention projects. The Pleasant Creek Pilot Watershed Project near Mt. Pleasant was one of these with construction beginning in 1954. Under the Watershed Protection and Flood Prevention Act of 1954, three projects were approved. The Mill Canyon-Sage Flat Watershed Project, authorized in 1956 and completed in 1961, was primarily flood protection. Two others, the Monroe-Annabella (1966) and Glenwood (1975) projects included irrigation water conservation and development. The original application for the Glenwood Watershed Project was changed to be a supplement of the Mill Canyon-Sage Flat Watershed Project. This project was reopened under the name Glenwood Watershed Project.

A Flood Plain Study was completed by the SCS for Richfield in 1974. This was done under the National Flood Insurance Program.

SCS planning was terminated on the Richfield-West Sevier Watershed Project in March 1977 after four years of planning and completion of the work plan and environmental impact statement; Increased costs from higher earthquake design standards made the project prohibitive, however, some flood control features have since been constructed by Richfield City.

Planning was approved for the Chalk Creek Watershed during January 1955. Planning for flood control and irrigation features continued until August 1956 at which time the sponsors voted to terminate planning. Sporadic interest continues but no action has been taken.